SECTION IV.—RIVERS AND FLOODS.

RIVERS AND FLOODS, SEPTEMBER, 1916.

By ALFRED J. HENRY, Professor in Charge.

[Dated: Weather Bureau Washington, Oct. 26, 1916.]

There was a rather marked absence of floods in all of the larger rivers of the United States during September, 1916. In the lower Rio Grande flood stage was reached on the 14th, Rio Grande City, Tex., but evidently the flood was confined to the extreme lower reaches of the stream, since the river at Eagle Pass, Tex., the next station upstream was below flood stage throughout the month.

Freshet stages prevailed on the Nueces River on the 15th, evidently due to local rains in the watershed. The rivers of South Carolina were near flood stage during the early days of the month, but fell steadily thereafter.

Hydrographs for typical points on several principal rivers are shown on Chart I. The stations selected for charting are Keokuk, St. Louis, Memphis, Vicksburg, and New Orleans, on the Mississippi; Cincinnati and Cairo, on the Ohio; Nashville, on the Cumberland; Johnsonville, on the Tennessee; Kansas City, on the Missouri; Little Rock, on the Arkansas; and Shreveport, on the Red.

SNOW DENSITIES IN THE SIERRA NEVADA.

By HENRY F. ALCIATORE, Meteorologist.

[Dated: Weather Bureau Office, Reno, Nev., Aug. 10, 1916.]

Students of meteorology can not but be impressed by the paucity of information that characterizes most of the present-day textbooks as to the density of snow and its underlying causes, and we may say, in passing, that some of the information contained therein is of doubtful value, if not actually misleading. For instance, in one of the latest works on meteorology (published in 1912) the author states that: "It requires from 6 to 30 inches of snow to make an inch of water, depending on the lightness of the snow; the average value, however, is about 10."

Now, in terms of density this means that one kind of snow may have a density of 17 per cent and another kind 3 per cent. As this writer does not tell his readers whether freshly fallen or old snow is meant, that statement leaves much to be desired as to accuracy and completeness. As a matter of fact, Ward [1] has found densities of 0.008 (March, 1876) and 0.020 (December, 1874), and Chassant [2] mentions one of 0.024 (L'Hérault, March 1887); Mougin and Bernard [2] (July, 1903) found a density of 0.344; all of the above values are for fresh snow. As to old snow, densities of 0.450 are very common in the spring; Cole,[3] of the United States Weather Bureau, found a density of more than 80 per cent near the ground in a deep snow cover in the Sierras. As a rule fresh snow is less dense than old snow, but exceptions are met with occasionally. Schreiber [4] made some measurements at Potsdam in 1896 with the following results:

Results of measurements of snow densities by Schreiber at Potsdam-Berlin, 1896.

Dates.	Old snow.		New snow.	
	Depth.	Density.	Depth.	Density.
	Mm.		*Mm.*	
Jan. 9	39	0.27	11	0.04
Jan. 16	71	0.16	31	0.18
Feb. 15	78	0.07	78	0.07

"A simple consideration of the difference between fresh and old snow," says Bracke,[4] "shows that temperature, humidity, direction of the wind, fogs, and clouds, are many factors which intervene to produce variations in the physical state of a snow cover; it is of the greatest importance to state the condition of the weather when making measurements."

In the spring of 1916 a series of snow surveys was made by the United States Weather Bureau in the Tahoe, Carson, and Walker watersheds, in cooperation with the University of Nevada. The several snow courses lay within a quadrangle about 58 miles long, by 45 wide, with its northern edge in latitude 38° 58′ N., and its eastern edge in longitude 119° 25′ W. According to A. H. Palmer,[5] this includes the region of heaviest snowfall in the United States. In all, 11 courses were laid out, in each of which 39 to 40 measurements, 50 feet apart, were made with a snow sampler and spring balance devised several years ago by Dr. J. E. Church, jr., meteorologist of the University of Nevada. The depth of the snow cover, in inches, was measured with the sampler tube, while the water content was obtained by weighing the tube and its core of snow with the spring balance, the dial of which gives directly the water equivalent of the snow in inches. The mean density of the snow is obtained by dividing the water content by the depth of the snow.

The courses at Meyers Station, Cal., Genoa Summit, Nev., and Freels Peak, Cal., were surveyed on March 17 and 18, and April 16, respectively; those at Grass Lake, Blue Lakes, Burnside Lake, and Williams, Cal., on March 17, 24, and 26, respectively; and those at Pickle Meadow, Willow Flat, Cinque Mountain, and Big Meadow, Cal., on April 4, 5, 8, and 9, respectively. This work was not undertaken by the Government and the university for experimental purposes, but with the view of establishing a basis for the correlation of snowfall and run-off in these watersheds, and estimating the available water supply stored in the snow.

To ranchers, hydroelectric engineers, and managers of municipal water plants and reclamation projects in Nevada, each season's available run-off from Lake Tahoe (whose sole outlet is the Truckee River) is of great importance. How the snowfall and run-off in the Lake Tahoe watershed have been correlated, and forecasts of the probable maximum summer level in that lake made possible thereby by the writer, have been explained in another paper.[6] Here we shall confine ourselves to a considera-

[1] *Wengler, Fritz.* Spezifische Dichte des Schnees. Berlin, 1914. p. 14.
[2] *Bracke, A.* La densité de la neige. Bruxelles, 1906. pp. 5, 18.
[3] In an unpublished MS. report of 1913, in Weather Bureau files.
[4] Bracke, op. cit., p. 9, 23.
[5] This REVIEW, May, 1915, 43:217.
[6] *Alciatore, Henry F.* A method of forecasting the maximum summer level in Lake Tahoe ... MONTHLY WEATHER REVIEW, July, 1915, 44:407-9.